Attachment E
Questions and Answers
May 16, 2007

General

1. How was the scope of the South Boulder Creek Flood Mapping Study determined?

   The flood mapping study scope was developed in response to the South Boulder Creek Major Drainage Planning, Phase A Report, developed by Taggart Engineering Associates, Inc. in 2001. The Phase A Report proposed flood mitigation alternatives to eliminate the potential for flooding identified in the west valley. However, community uncertainty and concerns about the Phase A study effort, the accuracy of an associated hydrologic analysis, and the proposed level of flood mitigation required in the plan resulted in local rejection of the report and public demands for a detailed flood risk assessment.

   Recommendations about defining the hazards and problems created by South Boulder Creek flooding and the level of technical analysis and evaluation needed to develop community acceptance of the results were presented to City Council by the Independent Review Panel (IRP) and the Citizen Advisory Group (CAG) in August 2001. The IRP included local floodplain professionals, Dr. Gilbert White, Mary Fran Meyers, Dr. Rich Madole, Brian Hyde and Dr. Jonathan Friedman, convened at the request of City Council to assess and recommend improvements in the City's approach to floodplain management and mitigation. The CAG was convened as part of the Phase A community process to provide input and recommendations for floodplain management and mitigation planning from the citizen's perspective.

   City Council accepted the IRP and CAG recommendations and a formal Hydrology Advisory Panel (HAP) made up of nine professionals with extensive background in multiple disciplines dealing with flood hydrology studies was convened in December 2001 to outline and determine a detailed scope of work to complete an updated flood study for South Boulder Creek. The HAP was committed to develop a state of the art scope of work that would produce results with a high level of confidence. Critical study elements outlined by the HAP included an online resource atlas, updated climatology, multiple-approach hydrology analysis, two-dimensional hydraulic modeling, multiple storm frequency risk assessment and extensive public involvement process.

   The recommended scope of work determined by the HAP was reviewed and accepted by the IRP and representatives of the city of Boulder, Boulder County, University of Colorado and the Urban Drainage and Flood Control District in late 2002. It was advertised as part of the original request for proposals (RFP) posted for response by Feb. 28, 2003. HDR Engineering, Inc. was selected to conduct the South Boulder Creek Flood Mapping Study in August 2003. The final scope of work connected with the HDR study contract is available online at:

http://www.southbouldercreek.com/media/SBC%20SCOPE%20OF%20WORK.PDF

2. The South Boulder Creek floodplain has been studied several times in the past. Why is another study needed?

   The study is intended to replace the current regulatory mapping based on a 1986 United States Army Corps of Engineers (USACE) study that is currently adopted by the City, Boulder County and the Federal Emergency Management Agency (FEMA). This study is in need of updating because it does not identify the flood risk in the West Valley or South Boulder Creek.

   The previous study developed by Taggart Engineering Associates, Inc. proposed alternatives to eliminate flooding in the West Valley without first restudying the floodplain and defining the flood problem. The City Council, Board of County Commissioners and the public at large rejected this approach and indicated that new floodplain mapping was needed before flood mitigation planning could occur.

   The new flood mapping study is intended to first define the flood problem and answer questions about where and to what extent flood risks exist. Once community understanding is achieved, a public planning process can then move forward in developing flood management and mitigation options.

3. Why should the public expect this study to be any different than the previous studies?

   There are several ways in which this technical study is different than previous studies:

   - This study separates the technical floodplain mapping analysis from the public discussion about how the community can mitigate flooding. Achieving community understanding first about the flood problem and its risks provides the basis for a public planning process to develop flood management and mitigation options.
   - This study combines some of the best technical expertise in floodplain analysis with a public involvement plan that will include the public as a partner from the very outset of the project.
   - This study will take advantage of a more technologically advanced approach that allows for a much finer level of analysis than previous technology allowed.

   This is perhaps the most comprehensive and thorough floodplain mapping study ever done in this region. The City is confident that the multi-dimensional scope of this study will produce sufficient detail and understanding of the South Boulder Creek flood hazards, and will clearly define the flood problem the community faces in this area.

4. By the time the study is approved will another technological advance yield new and different results?

The study team used the most scientifically defensible data and analytical approach available at this time. Technology is continuing to improve, but there is a great need for new flood hazard mapping that appropriately recognizes the flood risks in the South Boulder Creek area.

5. Will this study explore alternatives for flood management and mitigation?

No. This study is intended to define the flood problem not solve it. This study is a technical analysis to determine the likelihood of flooding, the conditions that are likely to cause flooding, and the areas that are most likely to be impacted by flooding. It is critical to understand the flood problem before the community can begin to discuss how to mitigate the flood risk.

The flood mapping study will produce a new regulatory flood map to replace the outdated 1986 regulatory map. The new regulatory flood map will be used to regulate floodplain development and define the flood zones on FEMA's Flood Insurance Rate Map used to determine flood insurance premiums.

The risk assessment component of the flood mapping study will be completed in 2007 and will be used to support subsequent flood management and mitigation planning. A community planning process with direct public involvement to develop floodplain management and mitigation alternatives will begin as soon as practical after the flood study results have been accepted by FEMA, Boulder County, the City of Boulder and other agencies.

Currently, $100,000 has been appropriated in the City's Capital Improvement Program (CIP) to begin the flood management and mitigation planning process in 2007. However, this funding may be needed to complete the flood mapping study itself. Additional funding has been allocated in the City's CIP in 2008 ($150,000) and 2009 ($300,000) to complete flood mitigation planning. In addition, $3,000,000 has been allocated in 2010 to help fund selected flood mitigation improvements, whatever these might be. The City is also pursuing Federal funding for flood mitigation planning and construction.

6. How much money has been spent on the flood study to date?

Approximately $1,400,000 has been spent on the flood mapping study to date.

7. Will this study look at water quality in South Boulder Creek?

Water quality investigation and analysis is not in the scope of the flood mapping study. City staff is looking into available water quality information that may be included in the online Resource Atlas. South Boulder Creek is currently identified as having one of the highest water quality ratings in the state.

Public Involvement Process

8. Where can I find the most comprehensive information concerning the South Boulder Creek Flood Mapping Study?

   Comprehensive information is available on the South Boulder Creek Website – go to:

   www.southbouldercreek.com

9. Are there higher resolution floodplain maps available than presented on the Web site?

   The flood hazard maps posted on the South Boulder Creek Website are in Adobe Acrobat pdf format to allow convenient Internet access with limited download requirements. These maps allow a viewer to pan around the image and to zoom in to areas of particular interest. However, the resolution is of lower quality than may be offered in a GIS format.

   The City is also hosting an ArcIMS Web site for the South Boulder Creek flood maping study (http://gisweb.ci.boulder.co.us/website/pds/sbc_flood/viewer.htm). This Web site allows the viewer to select various mapping study results and zoom in to areas of particular interest at an even higher resolution.

   What are the next steps with this study? When will FEMA approve or disapprove the new flood maps?

   City staff anticipates that the flood mapping study will be submitted to FEMA for review and approval in June 2007. The FEMA review period is expected to take 6-9 months. FEMA will announce the completion of their review and request public comment via the Federal Register, most likely in early 2008

   Who is the primary contact person at the city for the flood mapping study?

   The City's Project Manager is Bob Harberg who may be contacted at:

   E-mail: harbergb@bouldercolorado.gov
   Telephone: 303-441-3124

10. What is the Peer Review Evaluation Panel?

    The Peer Review Evaluation Panel (PREP) is comprised of three Boulder area residents with scientific knowledge in water resources and floodplain management. The PREP was established to review and evaluate the technical aspects of the SBC Study on behalf of the public interest and to offer an independent assessment to ensure the study meets generally accepted standards of engineering practice for flood hazard mapping. The PREP also advised the study team about how effectively the study results are presented to the public in order to ensure the greatest level of understanding for a non-

technical audience. To access the PREP comments regarding the flood study results, go to:

http://southbouldercreek.com/pageinpage/publicinvolvement_prepbios.cfm

Climatology/Hydrology Analysis

11. Where can I find the most comprehensive information concerning the results of the revised climatology/hydrology analysis?

    The Climatology/Hydrology Summary Report dated February 2007 is available on the South Boulder Website – go to:

    http://www.southbouldercreek.com/pageinpage/projectbackgrounddocuments.cfm

12. The current hydrology results increased the original 2005 hydrology results by as much as a factor of two. Why were these changes made?

    Comments received from FEMA, the US Army Corps of Engineers, the Urban Drainage and Flood Control District, the Colorado Water Conservation Board and members of the public following submittal of the original hydrology to FEMA in 2005 indicated a concern that the hydrology underestimated the flood hazard. The comments recommended additional research and analysis to expand and refine the scientific data used to produce the results.

    The study team was able to collect additional storm records and utilize a new computer-based analytical tool to expand the climatology analysis from 13 to 50 storms. The expanded data offered a better understanding of the size and shape of regional storms. The results determined that local storms cover more area, produce more rainfall and result in greater peak flows and volumes than previously indicated.

13. How does the new hydrology compare to the currently adopted 1986 steady-state hydrology?

    The table below presents 100-year peak flow rates at various locations for the new hydrology as originally determined in 2005 and subsequently revised in 2006, and for the currently adopted 1986 steady-state hydrology. Flood flow rates are presented in terms of cubic feet per second (cfs).

South Boulder Creek
100-year Flood Flow Rates (cfs)

Location	Original (2005) Flow Before Routing (1)	Revised (2006) Flow Before Routing (2)	Revised (2006) Flow After Routing (3)	Flow from Current 1986 USACE Regulatory Study After Routing (4)
Eldorado	3260	4520	4340	4800
Hwy 93	3940	7120	4900	5740
US 36	3930	7690	5850	6200
Baseline Rd	3930	8770	6900	6400
Confluence	3910	8910	5430	6600

1. This is the flood flow rate based on the study's original rainfall/runoff model prior to routing through the hydraulic model and was submitted to FEMA in April 2005.
2. This is the flood flow rate based on the study's revised rainfall/runoff model prior to routing through the hydraulic model that is proposed for consideration.
3. This is the flood flow rate based on the revised rainfall/runoff model after routing through the hydraulic model that is proposed for consideration.
4. This is the flood flow rate based on the current 1986 USACE regulatory model after routing.

14. How do the changes in the flood mapping study's findings relate to data generation (real data vs. simulated), and how is the level of confidence determined?

Changes in the study results apply only to the design storms. The design storms are by definition, generated data, but the data generation was based on the analysis of real data from 50 thunderstorms and seven general storms. This represents the most complete data set available for anlaysis that is applicable to South Boulder Creek.

The study team is in the process of developing quantitative confidence limits on the design storm discharges.

15. How were the increased design storm values determined and what drives increased storm values?

The South Boulder Creek design storms developed in the 2005 climatology results were reviewed by FEMA, the US Army Corps Of Engineers, the Urban Drainage and Flood Control District (UDFCD), the Colorado Water Conservation Board and the Peer Review Evaluation Panel (PREP). Review comments recommended increasing the storm sample from the original 13 storms used to create the design storm.

HDR hydro-meteorologists used surface rainfall observations available from the National Weather Service, Colorado Climate Center, National Climate Data Center and the UDFCD to identify thunderstorms that produced a 100-yr rainfall in and along the Colorado Front Range foothills from Fort Collins to areas just north of Palmer Divide. Once identified, the Storm Total Precipitation product (STP) for National Weather Service WSR-88D Doppler radars located at Watkins, Colorado and Cheyenne, Wyoming were used to define the spatial storm rainfall pattern. This pattern was then "ground-truthed" with surface rainfall observations to develop a comprehensive storm rainfall pattern.

The STP product (released in mid-2005) offers computer generated storm analysis that was not previously available and made it economically possible to increase the storm sample from 13 manually analyzed storms to 50 storms. The resulting 100-yr design storm (based on a thunderstorm event) **was spatially larger (~15 percent)** than the original thunderstorm and was observed to be quasi-stationary during heavy rainfall production periods.

The increased design storm volumes were caused by two factors:

1. The increased size of the final design thunderstorm as described above, and

2. Application of a stationary design storm aligned along the basin below Gross Reservoir. The original design storm was moving across the watershed in a manner consistent with historical South Boulder Creek storms.

16. Have extreme "dooms-day" storm situations been considered in the flood mapping study? (i.e. If Gross Reservoir is at capacity during spring runoff season and the 100/500-year storm hits simultaneously.)

The flood mapping study was designed to develop a scientifically based, purely technical analysis that would define the most accurate and physically real results possible in order to truly "define the flood problem." This required analyzing the most probable conditions expected rather than the worst case conditions.

To understand and consider the impacts of more extreme or "worst case" flooding, the study has included simulations of the 500-year storm, 100-year and 500-year storms with and without the CU-South Campus berm and the transposition of two extremely large historical events; the 1976 Big Thompson storm and 1997 Ft. Collins storm. Both extreme storms were significantly larger than the 500-year storm.

17. Does the flood mapping study include releases from Gross Reservoir and irrigation ditch diversions?

Yes. The flood mapping study includes releases from Gross Reservoir based on annually observed conditions and expectations. Diversion of flood waters from the

stream into irrigation ditches was based on the capacity of each ditch and its location to intercept and convey flows as determined in the hydraulic model.

18. Has the flood mapping study considered all the variables: season, ground saturation, temperature and snow pack?

The study team attempted to incorporate as many variables as possible into the analysis. Changes in seasonal rainfall and temperature were explored. Irrigation practices and rainfall preceding design storms were considered. The model represents basin conditions that are probable at the time of the storm – late spring to early summer for the general storm and mid to late summer for the thunderstorm.

19. Has the revised hydrology been re-submitted to FEMA for review?

No. The study team is working to complete the floodplain delineation mapping for the flood study so that the climatology, hydrology and hydraulic analyses can be submitted together for a comprehensive FEMA review. The updated results have not yet been forwarded to any review agencies for comment. Please refer to the answer to question 8 for more information about the timetable for submitting the revised hydrology to FEMA.

20. How are water table levels and seasonal changes in groundwater addressed in the hydrology analysis?

The flood mapping study is designed to determine surface flows in the South Boulder Creek floodplain and does not provide a detailed analysis of groundwater conditions. However, understanding general groundwater conditions and the level of anticipated ground saturation is important in determining flood water infiltration affecting flood runoff. The study reflects groundwater and soils conditions through the model calibration efforts.

The model does not explicitly compute groundwater depths or changes in groundwater levels during a flood. Such level of resolution is not necessary to compute surface runoff during a flood.

21. Is the flood model calibrated to the Eldorado Springs gage data? If not, will FEMA question the study's results?

The hydrology model was calibrated using extensive rainfall data for three storm events (September 1938, May 1969, 1998 thunderstorm). The calibration was then validated through a "blind" analysis of a fourth storm event (1999 thunderstorm).

Model calibration was not based directly on the Eldorado Springs gage because this is the only gage record for the South Boulder Creek basin and it is located well above the valley where flooding is critical. However, the calibration analyses using the four

storms produced results consistent with flow rates and storm volumes recorded at the Eldorado Springs gage for these events.

The hydraulic model was calibrated using historical information and visual records from the 1969 flood. The base model was refitted with topographic conditions representing those that existed in 1969, and the extent of flooding was compared to photographic evidence and recounts from area residents.

The overall calibration effort produced successful results that were consistent with the benchmark storm events and the Eldorado gage record. This is compelling evidence that the model appropriately represents the watershed and the design storms for this area. Further adjustment of the calibrated model to directly match the Eldorado gage values would adversely affect the validity of this comparison and weaken the credibility of the results.

22. Where do the Eldorado Springs gage volumes come from?

Eldorado gage volumes were developed using recorded flow rate data. For each year of gage record, the study used the day with highest peak flow and calculated a 24-hour volume for that day. The average daily flow rate for these days was then used to calculate corresponding flow volumes used to determine peak flows in the flood frequency anlaysis.

The flood frequency analysis used a standard statistics package developed by the U.S. Army Corps of Engineers (Flood Frequency Analysis package) that applies the log Pearson Type III distribution together with a station skew. This analysis determines benchmark volumes corresponding to flows with specific return periods (i.e. 10-,25-, 50-, 100-, and 500-years).

23. How flexible are the simulations/models? Can they incorporate different calibrations and inputs?

The MIKE FLOOD model used for South Boulder Creek integrates hydrology and hydraulics simulation modules into one program. This modeling tool represents the state-of-the art in hydrologic/hydraulic modeling. MIKE FLOOD offers significant flexibility in representing various watershed and floodplain conditions. This flexibility along with the 1D/2D capabilities was the basis for selecting this program.

The South Boulder Creek model will allow the City to evaluate and simulate the affects of various conditions including the impacts of blockage, physical land features, and various storm conditions. This offers a powerful tool in evaluating future opportunities for floodplain mitigation and land use activities.

24. Have the impacts of global warming been included in the flood mapping study?

The study included the addition and analysis of regional rainfall records for the last 30 years to update the 1972 NOAA Rainfall Atlas. This additional data did not change rainfall rates in the South Boulder Creek basin and did not reflect any trends that could help define the expected impacts of global warming. Given this, specific affects or adjustment factors to account for global warming could not be included in the study with any scientific confidence.

The study team is sensitive to and concerned with the affects of global warming and climate change. A recent draft American Meteorological Society Statement on Climate Change, now under review by the AMS Council, has been posted to the AMS web site: http://www.ametsoc.org/policy/draftstatements/index.html. This draft statement provides a very good summary of current science consensus on climate change. In general it supports the likelihood of more frequent, larger and more intense thunderstorms in the Western United States.

25. Why is South Boulder Creek being allowed to go almost dry in the winter? It appears to have gotten worse over the last 30 years and is harming the fish.

The focus of this study is the examination of high flow events, so low periods were not studied. The study team will look into available information that may respond to this question and post it on the Web site.

26. It appears that the consultants used the wrong data in developing the original climatology and hydrology in 2005 that has now been changed. Why should the public pay to correct their errors?

The consultants have not requested payment for any work done to correct errors. The revision to the climatology and hydrology was the result of adding storm data to increase the sample from 13 to 50 storms as recommended in review comments received from FEMA and others in 2005. The City has only been billed for additional work necessary to incorporate this new data into the analysis.

Hydraulic Analysis and Flood Hazard Mapping

27. Where can I find comprehensive information concerning the results of the hydraulic analysis to date?

The Floodplain Hydraulic Modeling Report dated February 2007 is available on the South Boulder Website – go to:

http://www.southbouldercreek.com/pageinpage/projectbackgrounddocuments.cfm

28. The depth of flow in Dry Creek Ditch is not shown properly. The ditch is deeper than reported on the floodplain information presented.

The modeling of ditches and culverts is based on information assembled during the course of the study. The study uses high resolution one-foot contour topographic mapping developed in 2003, record drawings from previous studies, and field survey information to assemble the best possible data set. As with any model of such complexity and large area of coverage, errors or misinterpretations are possible. The study team will explore such areas of concern as the study continues and detailed quality reviews are completed. Members of the public are invited to identify any other areas of concern and report these to the team via the project Web site.

29. How is at risk floodplain status determined in relation to outbuildings, sheds, septic and leech fields?

The identification of properties within the various flood zones was based primarily on habitable structures that are impacted. Efforts were made to screen out sheds and other non-habitable structures. Any questions related to specific structures should be reported to the study team via the project Web site.

30. Can the high hazard zone be changed as part of the flood mapping study to address structures in danger and can we call to discuss structures in question?

The high hazard zone is defined by the physical properties of flood depth and velocity, and is determined without regard to individual structures affected. Changes to the high hazard zone proposed as part of the flood mapping study or requested by members of the public must be supported by technical data.

Questions related to specific structures and the impact of the high hazard zone may be submitted to the study team via the project Web site.

31. How are the floodplain zones (AE, X, Conveyance (Floodway), and High Hazard) identified on the floodplain maps defined?

The flood zones are defined as follows:

- **Zone X**: Areas of moderate flood risk that are determined to be within the 500-year floodplain where there is a 0.2-percent chance of being equaled or exceeded in any given year; areas in the 100-year floodplain where average depths are less than one foot; and areas protected from the 100-year flood by levees.

  Zone X areas are not subject to local floodplain regulations. Zone X buildings are eligible for the Preferred Risk Flood Insurance Policy (PRP), which is a lower-cost option for low to moderate risk flood areas. Insurance eligibility is

based on the FIRM that is in place on the effective date of the policy, and NFIP grandfathering rules do not apply.

- **Zone AE**: Areas of special flood hazard (high risk) inside the 100-year floodplain where flood water surface elevations have been determined. A 100-year flood event is a flood that has a one-percent chance of being equaled or exceeded in any given year.

  Restrictions apply to properties located in Zone AE pursuant to local floodplain regulations. All development improvements require a flood permit issued by the appropriate jurisdiction (City of Boulder or Boulder County).

  The purchase of flood insurance is mandatory for buildings located in Zone AE where the structure was purchased with a federally backed mortgage. This applies to all mortgages that are issued by a Federally-regulated lender. The purchase of flood insurance is not regulated or required by Boulder County or the City of Boulder.

  Properties that may be re-designated from Zone X to Zone AE as a result of the flood mapping study may take advantage of "NFIP Map and Zone Grandfather Rules." The grandfather rules recognize policyholders who have "remained loyal customers of the NFIP by maintaining continuous flood coverage" and/or "built in compliance with the FIRM that was in effect at the time of construction." These rules could offer lower-cost Zone X flood insurance instead of Zone AE flood insurance after the flood mapping is adopted.

- **Conveyance (Floodway) Zone**: Those portions of the floodplain required for passage (or conveyance) of the 100-year flood, based on an encroachment of the floodplain from the edges of inundation to a point where the 100-year flood profile (or water surface elevations) will be raised by no more than six-inches (for the city of Boulder, one foot for Boulder County). This definition considers a reasonable expectation of blockage at bridges and other obstructions by flood born debris.

  In the conveyance zone or floodway, any development, encroachment, obstruction or use that would result in any increase in the base flood elevation is prohibited. Boulder County additionally prohibits the development of structures for human occupancy in the floodway.

- **High Hazard Zone**: Those portions of the 100-year floodplain where an unacceptably high hazard to human safety exists. This is defined as those areas where the product number of velocity (measured in feet per second) times flow depth (measured in feet) equals or exceeds four, or where flow depths equal or exceed four feet. The high hazard zone applies only to lands annexed to city of Boulder.

In the high hazard zone, the construction, expansion or enlargement of any structure intended for human occupancy or establishment of a new parking lot, is prohibited. Additionally, any change in use of an existing structure intended for human occupancy from non-residential to residential is prohibited.

32. Will the flood mapping study impact flood insurance requirements?

Yes. The flood mapping study will replace the currently adopted Flood Insurance Rate Map (FIRM) used to set flood insurance premiums and identify mandatory flood insurance requirements. Areas identified in Zone A (i.e. AE and AO) are considered areas of special flood hazard (in the 100-year floodplain) and mandatory flood insurance requirements apply in this zone. Mandatory flood insurance is not required in X zones. However, flood insurance is available in all flood zones and flood insurance premium rates are adjusted accordingly.

33. What can property owners do to reduce the flood insurance impacts if their property is determined by the flood mapping study to be in the Zone A floodplain? Some property owners have heard about a type of "grandfathering" for flood insurance.

A discussion about flood insurance was presented early in the study. In summary, property owners who currently have and continue to maintain a flood insurance policy will have the option of retaining their existing insurance rate status when the new maps are adopted. This has been referred to as FEMA's flood map "grandfather" rules. Property owners without flood insurance at the time of map adoption would face the mandatory flood insurance purchase requirement based on the new floodplain designations.

For more information on the grandfather rules, go to http://www.fema.gov/pdf/nfip/hillsborough/grndfthr_sht.pdf.

34. Could I build a berm to protect my house or property, and would it reduce or eliminate flood insurance requirements?

Flood protection measures can help mitigate the impacts of flooding and reduce potential losses. Such measures could be as elaborate as constructing a berm around or flood proofing an at-risk structure, or as simple as relocating valuable records and possessions above the flood protection elevation. Construction of flood protection improvements may not adversely impact neighboring properties and must comply with building standards and engineering practices. They also require a permit from the City or County to ensure compliance with floodplain ordinances.

FEMA will not recognize flood protection or flood proofing measures for flood insurance purposes. While such measures may reduce the flood damage risk exposure, they will not eliminate the mandatory flood insurance requirement or reduce flood insurance premiums.

Risk Assessment

35. What is the purposes and status of the risk assessment component of the study?

The purpose of the risk assessment is to identify and quantify life safety, property damage and environmental risks associated with South Boulder Creek flooding. To assess the risk to life safety, important information includes inundation mapping and basin response time. Property damage assessments involve depth of flooding and the corresponding value of associated losses. Environmental risks consider erosion and sediment transport, the loss of vegetation and changes in the creek path.

The risk assessment will help to inform and educate those affected by flooding and support subsequent flood management and mitigation planning. The study has produced information identifying the flood hazard zones affecting individual properties (see Floodplain to Structure Address Table) that is available on the South Boulder Creek Web site. The risk assessment will be completed in 2007 to support the subsequent flood mitigation planning.

CU South Berm

36. What is the legal status of the CU-South Campus berm?

Construction of a berm on the CU-South campus property was originally approved by the Boulder County Planning Commission on February 20, 1980 under Special Permit #AR-79-4. The permit approved construction of an embankment and channel in the South Boulder Creek floodplain to provide flood protection for sand and gravel mining.

The berm was approved as a "land feature" in the floodplain and was not proposed as an official flood protection levee to remove property from the 100-year floodplain. Removing the land use floodplain zoning with a flood protection levee would have required review and approval by the Board of County Commissioners. The area landward of the berm remained in the 100-year floodplain as delineated on the 1979 Flood Insurance Rate Map (FIRM) for Boulder County.

The CU-South Campus area landward of the berm was removed from the 100-year floodplain following the completion of the 1987 Greenhorne & O'Mara Flood Hazard Area Delineation (FHAD) for South Boulder Creek as adopted by Boulder County and FEMA. Floodplain analysis discussed in the FHAD identified the berm as a natural land feature and determined that the area landward of the berm would be an ineffective flow zone during flooding. This area was officially removed from the 100-year floodplain on the 1990 Boulder County FIRM.

The berm was significantly enlarged, increased in height and strengthened following the university's purchase of the CU-South Campus property in 1996. Authorization to implement these modifications to the berm was approved by the Colorado Mined Land

Reclamation Board (MLRB) in 1997as part of a "Technical Revision" to the approved 1989 Deepe Pit Mine Reclamation Plan.

The MLRB may approve a technical revision to an approved reclamation plan under an effective mining permit without the consent and approval of external agencies such as Boulder County, the US Army Corps of Engineers and the city of Boulder. The MLRB approved the Deepe Pit technical revision following the City's and County's airing of opposition at the approval hearing.

Several members of the public have opined that the berm is not a legal land feature despite the series of governmental approvals that produced its current physical condition. However, there has been no legal determination that the berm is in violation of any local ordinances or state statutes.

37. Has the CU-South Campus berm been certified as a flood protection levee under FEMA standards?

No. Leonard Rice Consulting Water Engineers, Inc. (representing the Flatiron property seller in coordination with CU's acquisition) submitted technical documentation to FEMA on August 26, 1999 requesting "FEMA's review of a previously recognized levee" on the FIRM. Documents certified by professional engineers included a general report on the levee, a site plan and "as-constructed" surveys, a geotechnical engineering report, an erosion protection report and a CU operation and maintenance manual. Subsequent documentation submitted included an analysis of seepage along the berm to ensure the levee met structural stability requirements.

FEMA determined that the upper reach of the CU-South Campus berm satisfied all requirements of Section 65.10 of the National Flood Insurance Program (NFIP) regulations as indicated in FEMA's July 15, 2000 letter to Leonard Rice Consulting Water Engineers, Inc. This means that the structural integrity and maintenance and operations plans for the upper reach of the berm satisfy national standards for the construction of flood protection levees.

However, FEMA also determined that the lower reach of the berm did not meet the requirements of Section 65.10, and required additional data before the FIRM could indicate that the upstream reach of the levee provides protection from the 100-year flood. Additional data requested included the submittal of existing conditions topography and hydrologic and hydraulic analyses indicating the impacts of a levee failure on the lower reach. FEMA indicated that the levee certification could not be further processed until the requested analyses were submitted.

To date no existing conditions hydrologic and hydraulic analyses have been submitted to FEMA. As a result, the 1999 levee certification submittal was suspended and a complete new submittal will be required to process future levee certification. The South Boulder Creek Flood Mapping Study is the only hydrologic and hydraulic analysis being developed at this time. Levee certification of the CU-South Campus berm can not be

processed without completion of the flood mapping study to address hydrologic and hydraulic issues.

38. What are the South Boulder Creek floodplain impacts with and without the CU-South Campus berm, and why hasn't the study completed detailed 100-year and 500-year hydraulic simulations without the berm?

This berm or levee, although a man-made structure, is a significant existing physical feature and will dramatically affect the flow of flood waters and their associated hazards. For this reason, the proposed regulatory mapping has been modeled with the berm in place. This is consistent with the overall modeling approach that considers and includes all topographic features, including other man-made structures such as roadway berms, excavated channels/ponds and elevated roadway intersections. In addition, the study team recently completed modeling simulations using the study's revised (2006) hydrology without the CU-South Campus berm in place in an effort to better understand the floodplain impact of the berm. The results of these modeling simulations are presented as Figures 12a and 12b - Sensitivity Results Related to University of Colorado South Campus Berm with New Hydrology on page 28 of the Hydraulics Report dated Feb. 6, 2007. The Hydraulics Report states that the results of the evaluation indicated relatively minor changes for the two conditions (with berm and without berm), and that the berm actually reduces the amount of flood flow that spills away from the main channel and reduces flood flow rates in the West Valley.

The University previously submitted the berm for certification by FEMA, but the berm analysis/ certification process was postponed pending the submittal of the flood study results and flood hazard maps. If FEMA eventually certifies the berm, then the CU-South Campus property on the upstream (west) side of the berm would not be subject to flooding under the 100-year thunderstorm event. If FEMA eventually does not certify the berm, then a portion of the CU-South Campus property on the west side of the berm would be in the 100-year floodplain.

Staff's intentions are to submit to FEMA both hydrologies (with berm in place and without berm in place) and allow FEMA to analyze and review all the information. Since the berm is a significant existing physical feature that will affect the flow of flood waters, city staff's recommendation to FEMA is to adopt regulatory mapping with the berm in place.

39. How many structures are at risk with and without the CU-South Campus berm?

When compared to the current floodplain maps, the proposed flood mapping indicates similar flood hazards along the main stem of South Boulder Creek, but increased flood hazards in the West Valley area. The number of structures affected by the various flood hazard zones is presented in Table 2. This includes all structures including not only primary living units and businesses but also garages, sheds, storage lockers and other agricultural outbuildings.

Table 2
Number of Structures Affected
(Located in both city and county areas)

Flood Zone	Existing Regulatory	Proposed Regulatory
Floodplain AE	459	1137 (+678)
Floodplain X	291	1237 (+946)
Conveyance	30	237 (+207)
High Hazard	24	99 (+75)

These structures will be at risk with or without the CU-South Campus berm.

40. How is future development for the South Boulder Creek floodplain, the West Valley and CU impacted with and without the CU-South Campus berm?

Under either condition, with or without the CU-South Campus berm, development in the West Valley will become more restrictive in areas impacted by flooding. Because flooding in the West Valley is expected to be greater without the berm in place, development restrictions will also be greater. Development restrictions along the main creek corridor in the eastern valley are similar under both conditions. Development on the CU-South Campus property would be more impacted without the berm in place.

41. What are the benefits and disadvantages of certifying the CU-South Campus berm as a FEMA compliant flood protection levee?

The benefits of certifying the CU-South Campus berm as a FEMA compliant flood protection levee include:

- Officially recognizing the significant physical land feature that currently exists.
- Confirming that the existing berm meets technical standards to ensure structural integrity and continued long-term maintenance.
- Ensuring that the flood protection it provides to prevent additional West Valley flooding remains in place into the future.
- Confirming the use and acceptance of the existing conditions topography in the flood mapping study.

The disadvantages of certifying the CU-South Campus berm as a FEMA compliant flood protection levee include:

- Officially recognizing the berm as an approved flood protection land feature may not prevent new development from occurring in the levee shadow.
- Reducing options to remove the levee and replace it with other flood mitigation measures.

42. Has the study evaluated the CU-South Campus berm and its potential for failure?

The flood mapping study does not include a structural analysis of potential failure for the CU-South Campus berm. This evaluation is part of the FEMA berm certification process.

43. Could the CU-South Campus berm and property be transformed into a flood detention structure to mitigate South Boulder Creek flooding?

The evaluation of alternative mitigation measures is beyond the scope of this study. No evaluations have been performed that address the viability of berm transformation.

44. Will FEMA require hydraulic simulations with and without the CU-South campus berm as part of the floodplain study?

Hydraulic simulations will be submitted to FEMA with and without the CU-South campus berm as described above.

45. Who would be responsible for seeking and obtaining certification of the CU-South Campus berm as a FEMA compliant flood protection levee?

The owner of the CU-South Campus berm, the University of Colorado, is ultimately responsible for obtaining certification to recognize the existing physical feature as a FEMA compliant flood protection levee, and is then responsible for all operations and maintenance needs for the levee.

46. There is a perception that the CU-South Campus berm is protecting university property for future development by diverting flood flows into residential areas. Has political influence played a role in developing the study's findings?

No. The study team has endeavored to develop the flood mapping study in a scientifically defensible and purely technical manner. The flood mapping study is designed and intended to define the flood problem as accurately as is scientifically possible, and has no component proposing a predetermined outcome.